



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Kenji Otsu et al

Serial No. 10/034,616

Filed: December 27, 2001

For: OPTICAL CONNECTOR ALLOWING EASY POLISHING OF AN END  
FACE OF AN OPTICAL FIBER AND METHOD OF PROCESSING THE  
END FACE OF THE OPTICAL FIBER

DECLARATION

The Honorable Commissioner of  
Patents and Trademarks  
Washington, D.C. 20231

Sir:

I, Eriko Matsui, a translator, 2-21-10-101,  
Bessho, Hachioji-shi, Tokyo, Japan, declare that I am  
familiar with the English and Japanese languages and that I  
have prepared the English translation attached hereto,  
which is a full, true and faithful translation of the  
patent application filed with the Patent Office of Japan  
under Application No. 2000-401463 on December 28, 2000 to  
the best of my knowledge and belief.

I hereby declare that all statements made herein  
of my own knowledge are true and that all statements made  
on information and belief are believed to be true; and  
further that these statements were made with the knowledge  
that willful false statements and the like so made are  
punishable by fine or imprisonment, or both, under Section  
1001 of Title 18 of the United States Code and that such  
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Serial No. 10/034,616

December 5, 2003

Date

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(Translation)

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: The 28th day of December, 2000

Application Number: Patent Application No. 2000-401463

Applicant(s): JAPAN AVIATION ELECTRONICS INDUSTRY, LIMITED

November 26, 2001

Kozo Oikawa  
Commissioner, Japan Patent Office

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[To] Commissioner, Patent Office

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[List of Presented Documents]

[Name] Specification 1

[Name] Drawing 1

[Name] Abstract 1

[Registration Number of  
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[Proof] Required

(Translation)

[Name of Document] SPECIFICATION

[Title of Invention] OPTICAL CONNECTOR AND METHOD OF PROCESSING  
AN END FACE OF AN OPTICAL FIBER USED THEREIN

[Claim for Patent]

[Claim 1] An optical connector for establishing connection by bringing an end face of an optical fiber wire into contact with an end face of a mating optical fiber wire in a predetermined direction, said optical connector comprising a housing, an aligning portion fixedly coupled to said housing and having a hole for insertion of said optical fiber wire, a guide portion coupled to said housing for guiding one part of said optical fiber wire to said hole in said aligning portion, and a holding portion mounted on said housing to be movable in said predetermined direction for holding the other part of said optical fiber wire, said holding portion being fixed to said housing with said optical fiber wire inserted through said hole in said aligning portion, said holding portion being moved in said predetermined direction to adjust the amount of protrusion of said optical fiber wire from an end face of said aligning portion.

[Claim 2] The optical connector according to claim 1, wherein said housing, said aligning portion, and said guide portion are integrally formed with one another.

[Claim 3] The optical connector according to claim 1 or 2, wherein said aligning portion is a component integrally formed.

[Claim 4] The optical connector according to any one of claims 1 to 3, wherein said aligning portion has a first portion provided with a groove and a second portion put on said first portion to cover said groove, said hole being formed by said groove.

[Claim 5] The optical connector according to any one of claims 1 to 3, wherein said aligning portion has a first portion provided with a groove and a second portion put on said first portion to cover said groove, said second portion being provided with a groove faced to said groove, said hole being formed by said groove in said first portion and said groove in said second portion.

[Claim 6] The optical connector according to claim 4 or 5, wherein each of said grooves has a V-shaped section.

[Claim 7] A method of processing an end face of an optical fiber wire used in the optical connector according to any one of claims 1 to 6, said method comprising the steps of holding said housing by a polishing jig, moving said holding portion in said predetermined direction to press the end face of said optical fiber wire against a polishing surface of a polisher, and making said polishing surface polish the end face of said optical fiber wire.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

This invention relates to an optical connector and a method of processing an end face of an optical fiber used therein.

[0002]

[Prior Art]

In an existing optical connector, an optical fiber 1 is connected by the use of an optical component called a ferrule 2, as illustrated in Fig. 5. Specifically, as illustrated in Fig. 6, the ferrules 2 are adhered and fixed to a pair of the optical fibers 1, respectively. End faces 3 of the ferrules are polished into spherical convex surfaces and butted to each other through a split sleeve 4 to be connected. At this time, connection is carried out by a connection method in which the end faces 3 of the ferrules 2 are applied with pressing

forces, depicted by white arrows, by the use of elastic springs (not shown) so that core portions positioned at the tops of the spherical convex surfaces and serving as optical waveguide portions are elastically deformed and tightly contacted. By the above-mentioned connection method, no air layer is formed between the core portions and low-loss connection can be achieved. The connection by the above-mentioned connection method is called PC (Physical Contact) connection.

[0003]

Recently, following the demand for a smaller size of the optical connector and a narrower pitch, consideration is made of an optical connector for directly connecting optical fiber wires contained in the optical fibers without using the ferrules. In the optical connector of the type also, the PC connection is required in order to achieve low loss. The pressing force required for the PC connection is produced by bending the optical fiber wires and utilizing restoring force (hereinafter called a buckling load) produced by bending.

[0004]

[Problem to be Solved by the Invention]

In the optical connector for directly connecting the optical fiber wires, it is necessary to finish end faces of the optical fiber wires into mirror surfaces. As effective means for carrying out the mirror-surface finishing, there is a method in which cut faces are processed into mirror surfaces by cleavage cutting. By the cleavage cutting, however, a face angle  $\theta$  may be produced at the cut face of the optical fiber wire 5, as illustrated in Fig. 7. It is noted here that the above-mentioned buckling load is on the order between 0.2-0.4N. Therefore, depending upon the face angle  $\theta$  of the optical fiber, elastic deformation of the optical fiber wires 5 may be insufficient and sufficiently tight contact can not be assured between the end faces, as illustrated in Fig. 8 so that desired connection may not be achieved. Consequently, it is impossible to



achieve stable optical characteristics and low loss.

[0005]

Use is also made of a method of fixing the optical fiber wire to the optical component such as the ferrule by the use of a UV-setting adhesive or a wax and polishing the end face of the optical fiber wire. However, this requires time and labor for a curing process of the UV-setting adhesive or the wax, removal of these fixing agents, and so on. If the residue of the UV-setting adhesive or the wax which can not completely be removed is adhered to the end face of the optical fiber wire, optical characteristics will considerably be deteriorated, resulting in lack of reliability.

[0006]

It is therefore an object of this invention to provide an optical connector of the type of directly connecting optical fiber wires, which facilitates polishing of end faces of the optical fiber wires.

[0007]

It is another object of this invention to provide a method of processing an end face of an optical fiber, in which the end faces of the optical fiber wires in the above-mentioned optical connector are polished.

[0008]

[Means to Solve the Problem]

According to this invention, there is provided an optical connector for establishing connection by bringing an end face of an optical fiber wire into contact with an end face of a mating optical fiber wire in a predetermined direction, the optical connector comprising a housing, an aligning portion fixedly coupled to the housing and having a hole for insertion of the optical fiber wire, a guide portion coupled to the housing for guiding one part of the optical fiber wire to the hole in the aligning portion, and a holding portion mounted on the housing to be movable in the predetermined direction for holding the other part of the

optical fiber wire, the holding portion being fixed to the housing with the optical fiber wire inserted through the hole in the aligning portion, the holding portion being moved in the predetermined direction to adjust the amount of protrusion of the optical fiber wire from an end face of the aligning portion.

[0009]

The housing, the aligning portion, and the guide portion may be integrally formed with one another.

[0010]

The aligning portion may be a component integrally formed.

[0011]

The aligning portion may have a first portion provided with a groove and a second portion put on the first portion to cover the groove. The hole is formed by the groove.

[0012]

The aligning portion may have a first portion provided with a groove and a second portion put on the first portion to cover the groove, the second portion being provided with a groove faced to the groove. The hole is formed by the groove in the first portion and the groove in the second portion.

[0013]

Each of the grooves may have a V-shaped section.

[0014]

According to this invention, there is provided a method of processing an end face of an optical fiber wire used in the optical connector according to any one of claims 1 to 6, the method comprising the steps of holding the housing by a polishing jig, moving the holding portion in the predetermined direction to press the end face of the optical fiber wire against a polishing surface of a polisher, and making the polishing surface polish the end face of the optical fiber wire.

[0015]

[Mode of Embodying the Invention]

Referring to Figs. 1 and 2, description will be made of the structure of an optical connector according to an embodiment of this invention.

[0016]

In the optical connector illustrated in the figure, connection is achieved by bringing an end face 12 of an optical fiber wire 11 contained in an optical fiber 10 into contact with an end face of a mating optical fiber wire (not shown) in a predetermined direction 13. The optical connector includes an optical fiber guide or housing 14. The housing 14 has a front portion provided with an aligning portion 16 having a plurality of holes 15 for insertion of the optical fiber wires 11 and a guide portion 17 positioned behind the aligning portion 16, both of which are integrally formed using synthetic resin. The holes 15 are aligned in a single row. The guide portion 17 has a plurality of slits 18 arranged in a single row in correspondence to the holes 15. Each of the slits 18 serves to receive the optical fiber wire 11 to guide one part thereof to the hole 15 in the aligning portion 16. Instead of the slit 18, a chamfered portion for guiding the optical fiber wire 11 to the hole 15 may be formed. In case where the optical fiber wire 11 has an outer diameter of 125  $\mu\text{m}$ , the diameter of the hole 15 is selected to be slightly greater than the outer diameter of the optical fiber wire 11, for example, to be equal to 126  $\mu\text{m}$ .

[0017]

The housing 14 has a rear portion provided with a fiber holder or holding portion 21 mounted thereon to be movable in the predetermined direction 13. The holding portion 21 serves to fixedly hold the other parts of the optical fiber wires 11 and is fixed to the housing 14 with the optical fiber wires 11 inserted through the holes 15 in the aligning portion 16. Specifically, the holding portion 21 is movable in the predetermined direction 13 with respect

to the housing 14 by rotating a screw (not shown) and, if necessary, can be fixed to the housing 4. Therefore, after the holding portion 21 is moved in the predetermined direction 13 to adjust the amount of protrusion of the optical fiber wire 11 from an end face 22 of the aligning portion 16, the holding portion 21 can be fixed to the housing 14. The holding portion 21 comprises a lower cover 23 and an upper cover 24 for clamping the optical fiber wire 11 in cooperation therewith.

[0018]

In order to connect the optical fiber 10 by the use of the above-mentioned optical connector, the end faces 12 of the optical fiber wires 11 are brought into contact with and pressed against the end faces of the mating optical fiber wires in the predetermined direction 13 so that the optical fiber wires 11 are bent. Thus, by the use of a buckling load of the optical fiber wires 11, pressing force for carrying out the above-mentioned PC connection is produced. This pressing force can readily be adjusted by selecting the position of the holding portion 21.

[0019]

In the optical connector illustrated in Figs. 1 and 2, the housing 14, the aligning portion 16, and the guide portion 17 are integrally formed. Alternatively, these components may be produced as separate components and then fixedly coupled to one another.

[0020]

As illustrated in Fig. 3, the aligning portion 16 may comprise a first portion 26 provided with a plurality of V grooves (grooves having a V-shaped section) 25 formed on its upper surface and extending in parallel to one another, and a second portion 27 put on the first portion 26 and fixed thereto so as to cover the V grooves 25. In this case, the V grooves 25 correspond to the holes 15 illustrated in Fig. 5.

[0021]

As illustrated in Fig. 4, the second portion 27 may be provided with a plurality of V grooves (grooves having a V-shaped section) 28 formed on its lower surface and extending in parallel to one another. The first and the second portions 26 and 27 are fixed to each other with the V grooves 28 faced to the V grooves 25 on the upper surface of the first portion 26. In this case, the V grooves 25 and 28 cooperatively form holes for insertion of the optical fiber wires.

[0022]

Next referring to Fig. 1, description will be made of a method of processing an end face of the optical fiber fixedly held by the optical connector.

[0023]

Briefly, the housing 14 is held by a polishing jig (not shown) and the holding portion 21 is moved in the predetermined direction 13 so that the end faces 12 of the optical fiber wires 11 are pressed against a polishing surface of a polisher (not shown). The end faces 12 of the optical fiber wires 11 are polished by the polishing surface.

[0024]

In detail, the housing 14 is fixedly held to be perpendicular to the polishing surface of the existing polisher for the optical connector. As means for fixedly holding the housing 14 by the polisher, various means may be used. Next, a plurality of optical fiber wires 11 equal in number to or smaller in number than the holes 15 are inserted into the holes 15. Each optical fiber 11 may be either a single-core type or a multi-core type. Next, the holding portion 21 is moved towards the aligning portion 16 so that the end faces 12 of the optical fiber wires 11 are pressed against the polishing surface of the polisher so that the optical fiber wires 11 are bent to produce the buckling load. Thus, because the buckling load of the optical fiber wires 11 is used, it is possible to omit an

operation of fixedly holding the optical fiber by an optical component such as a ferrule.

[0025]

Thereafter, the polisher is driven to polish the end faces of the optical fiber wires 11 by the polishing surface. If the end faces 12 of the optical fiber wires 11 are varied in position, the holding portion 21 is moved in the predetermined direction 13 to control the bending amounts of the optical fiber wires 11. Therefore, even if the end faces 12 of the optical fiber wires 11 are varied in position, it is possible to control the bending amounts of all of the optical fiber wires 11 and to prevent the end faces from being left unprocessed. By the bending of the optical fiber wires 11, it is possible to confirm that the end faces 12 are being polished. Therefore, the housing 14 and the aligning portion 16 need not be brought into contact with the polishing surface. Accordingly, these components can be reused.

[0026]

By the above-mentioned method, the end faces 12 of the optical fiber wires 11 can be polished without changing the operation using the existing polisher and the operation of fixedly holding the optical fiber by the optical component such as the ferrule can be omitted. In addition, batch processing of a large number of the fibers is possible and mass producibility is excellent. Furthermore, conventional optical processing can be achieved so that the performance equivalent to or superior to that conventionally obtained can be realized.

[0027]

[Effect of the Invention]

As described above, according to this invention, it is possible to provide the optical connector of the type of directly connecting the optical fiber wires, which facilitates polishing of the end faces of the optical fiber wires.

Furthermore, it is possible to provide the method of processing the end face of the optical fiber, in which the end faces of the optical fiber wires in the above-mentioned optical connector are polished.

[Brief Description of the Drawing]

[Fig. 1]

A perspective view of an optical connector according to an embodiment of this invention with optical fibers attached thereto.

[Fig. 2]

A perspective sectional view of a part of the optical connector in Fig. 1 as seen in a different direction.

[Fig. 3]

An end view showing a modification of the optical connector illustrated in Fig. 1.

[Fig. 4]

An end view showing another modification of the optical connector illustrated in Fig. 1.

[Fig. 5]

A perspective view showing the state where a ferrule is connected to an optical fiber upon constituting an existing optical connector.

[Fig. 6]

A sectional view showing the state of contact between the ferrules, for describing the principle of the existing optical connector.

[Fig. 7]

A side view for describing the state of an end face of an optical fiber wire processed by an existing method.

[Fig. 8]

An explanatory side view for describing a problem in case where the optical fiber wire illustrated in Fig. 7 is used.

[Description of Reference Numerals]

- 10 optical fiber
- 11 optical fiber wire
- 12 end face of optical fiber wire
- 13 predetermined direction
- 14 optical fiber guide or housing
- 15 hole
- 16 aligning portion
- 17 guide portion
- 18 slit
- 21 holding portion
- 22 end face of aligning portion
- 23 lower cover
- 24 upper cover
- 25 V groove (groove having a V-shaped section)
- 26 first portion
- 27 second portion
- 28 V groove(groove having a V-shaped section)



[Name of Document] ABSTRACT

[Abstract]

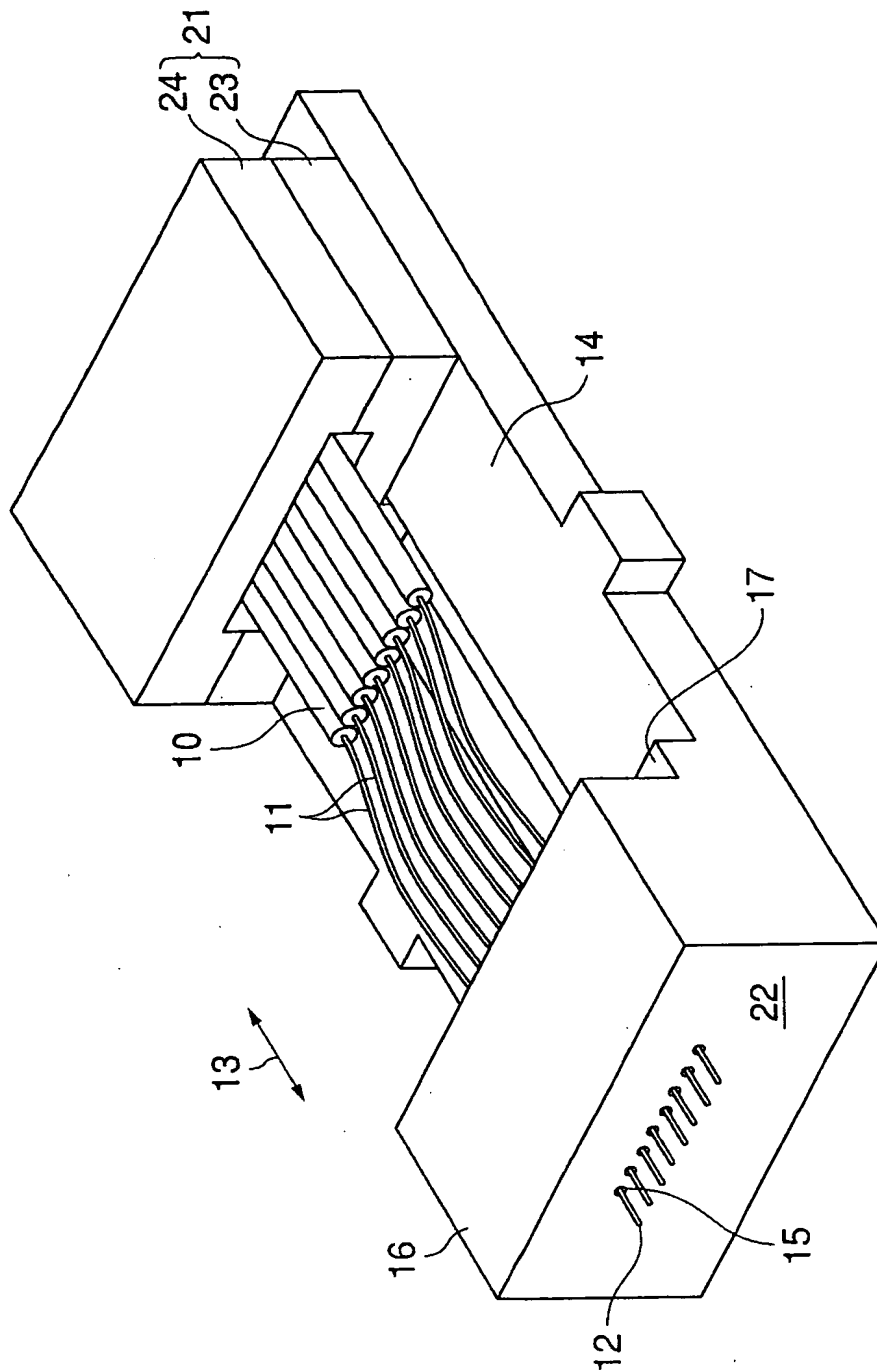
[Object] In an optical connector of the type of directly connecting an optical fiber wire, to facilitate polishing of an end face of the optical fiber wire.

[Solution] In an optical connector for establishing connection by bringing an end face 12 of an optical fiber wire 11 into contact with an end face of a mating optical fiber connector in a predetermined direction 13, a housing 14 is provided with an aligning portion 16 having a hole 15 for insertion of the optical fiber wire, and a holding portion 21 for holding the optical fiber wire. The holding portion 21 is movable in the predetermined direction. The holding portion is fixed to the housing with the optical fiber wire inserted into the hole in the aligning portion and serves to adjust the amount of protrusion of the optical fiber wire from an end face 22 of the aligning portion. The housing is provided with a guide portion 17 for guiding the optical fiber wire to the hole in the aligning portion.

[Selected Figure] Fig. 1

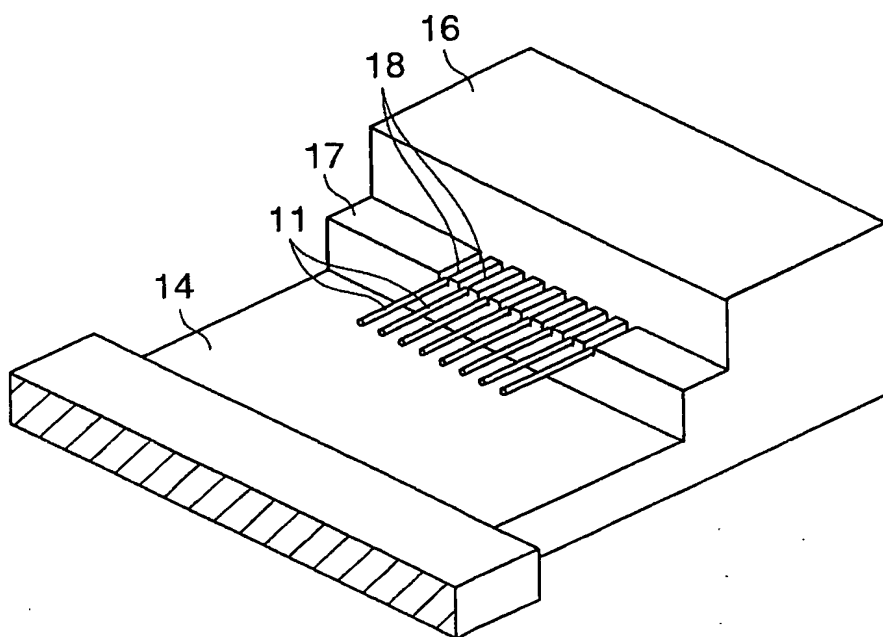
(Name of Document) DRAWING

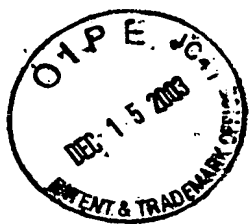
(Fig. 1)



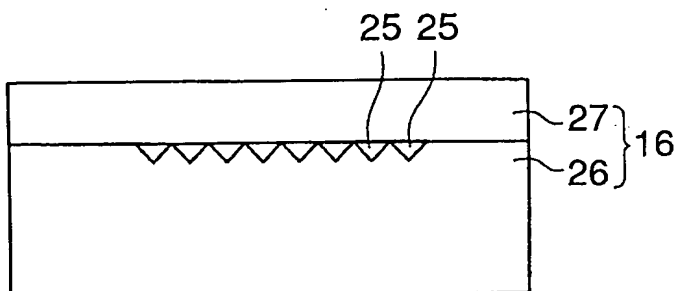


(Fig. 2)

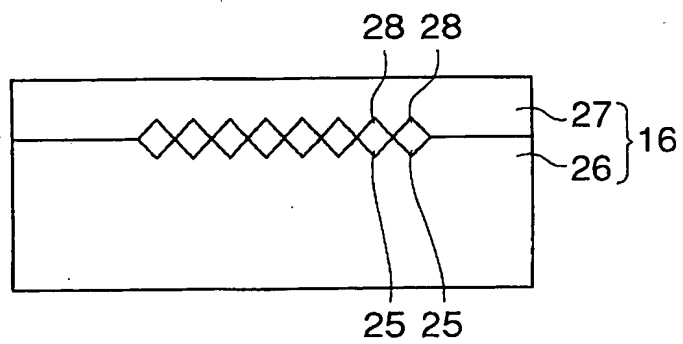


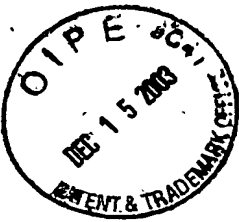


(Fig. 3)

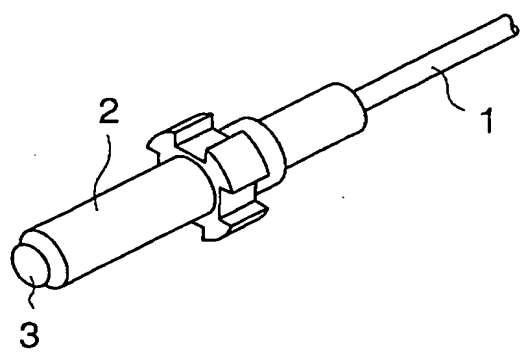


(Fig. 4)

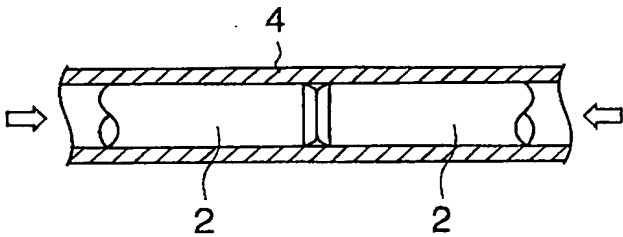




(Fig. 5)

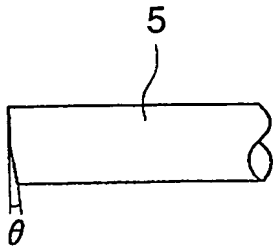


(Fig. 6)





(Fig. 7)



(Fig. 8)

